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(54) A printing apparatus

(57) The apparatus comprises a plurality of printing members (10) rotatably movable about a substantially vertical axis, in which at least one of the printing members is movable to occupy one of a plurality of operable positions in which the printing member is movable substantially vertically, wherein the vertical movement of the printing member in the or each operable position is independent of that of at least one other printing member. Eight printing members may be present. Movable ink trays (16) are associated with the members.

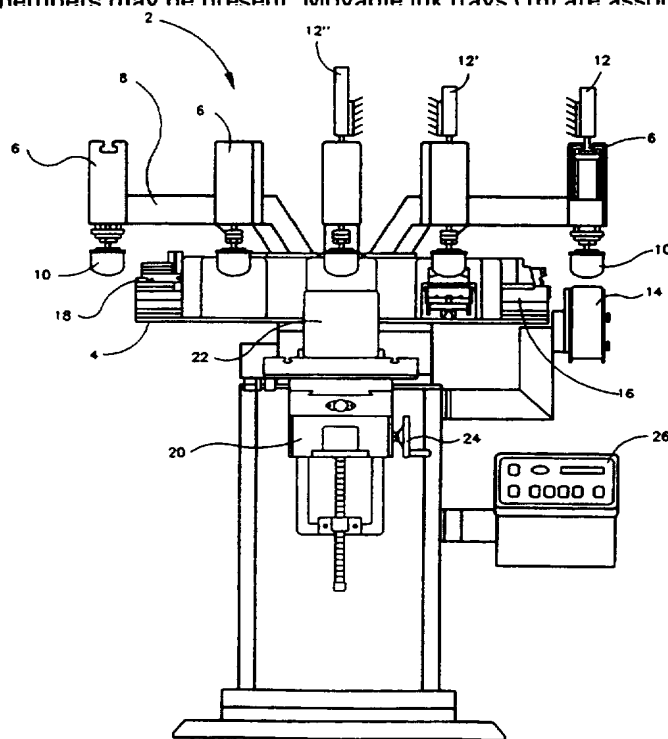


FIG. 2

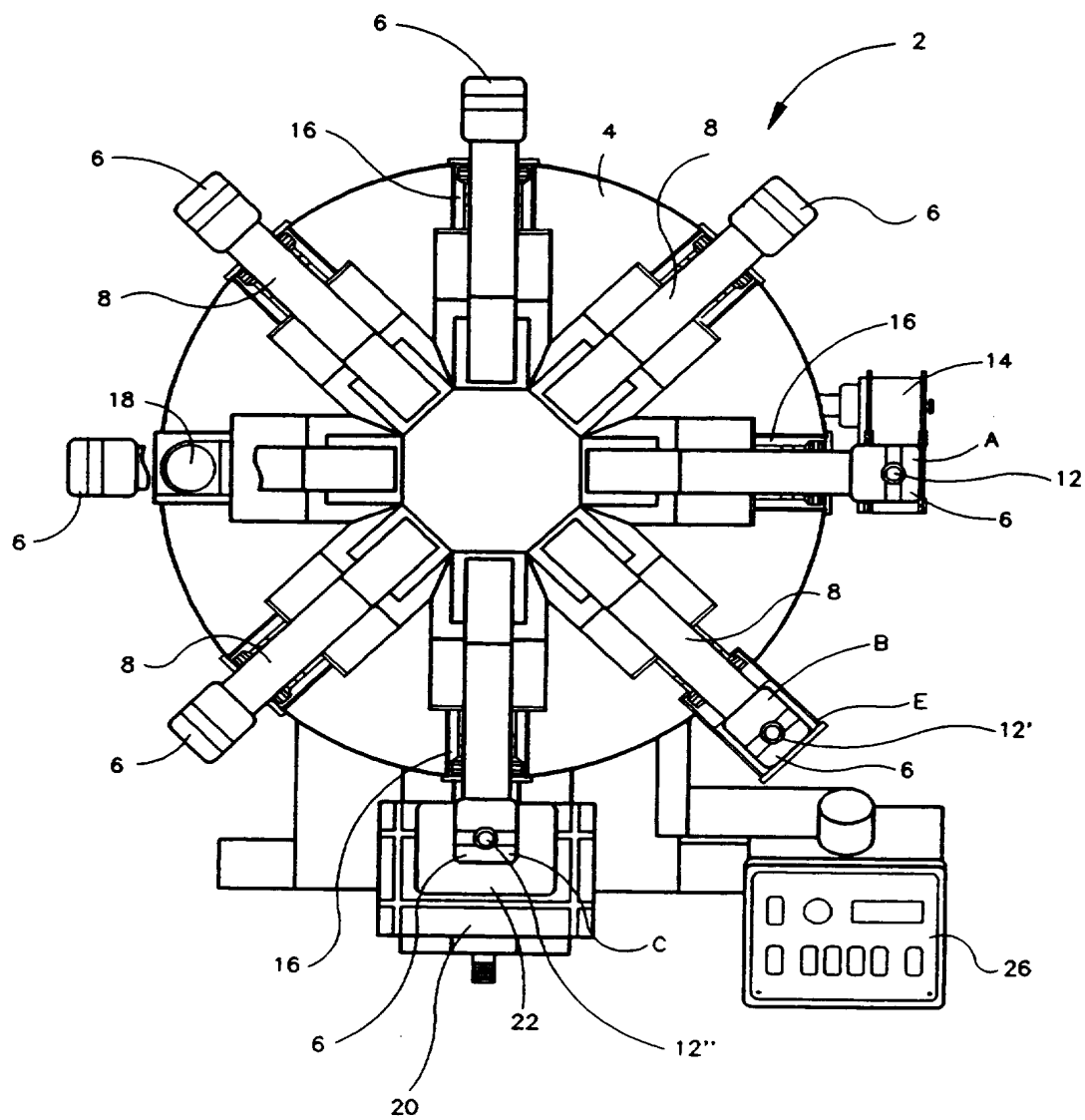


FIG. 1

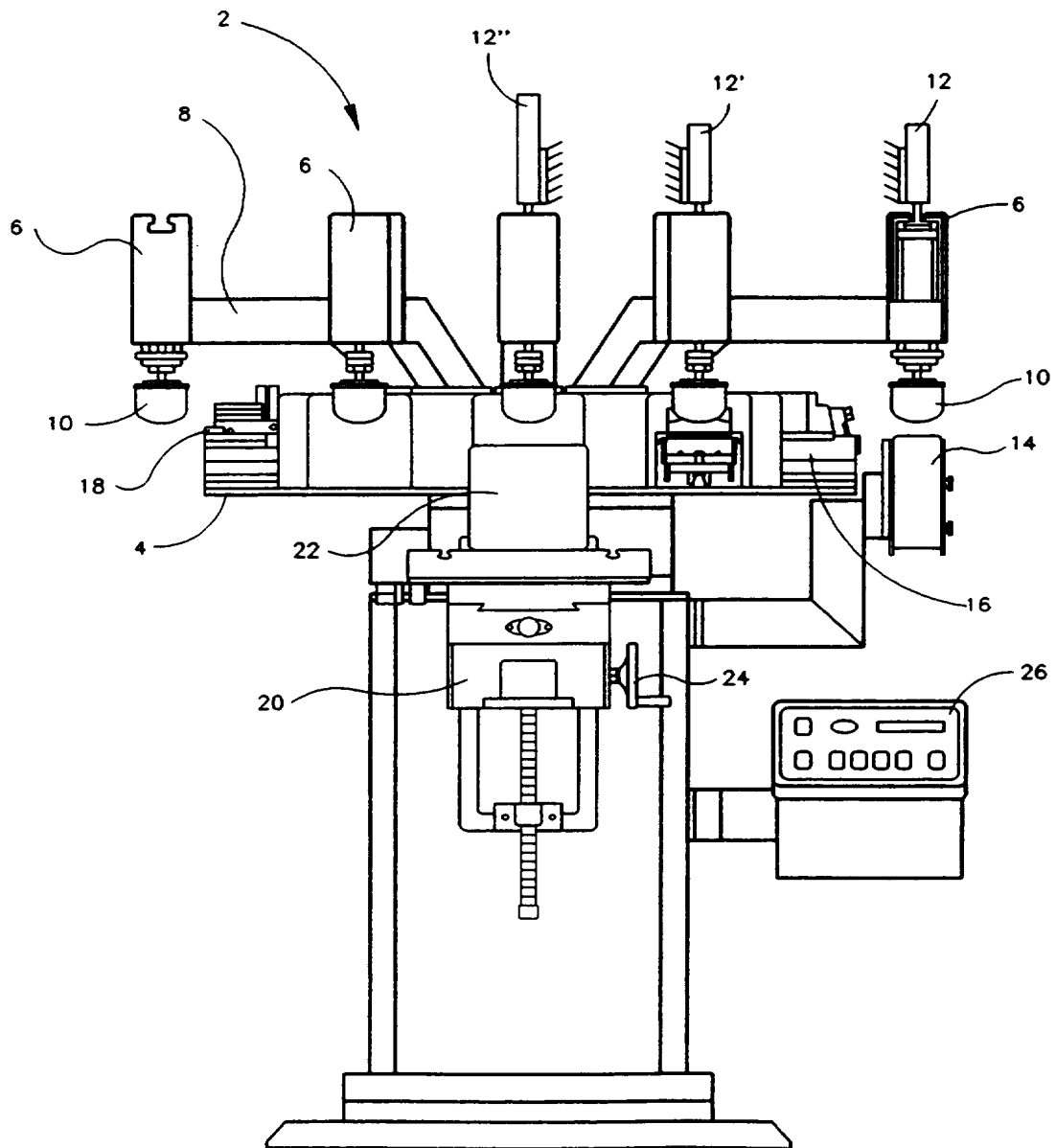


FIG. 2

3/15

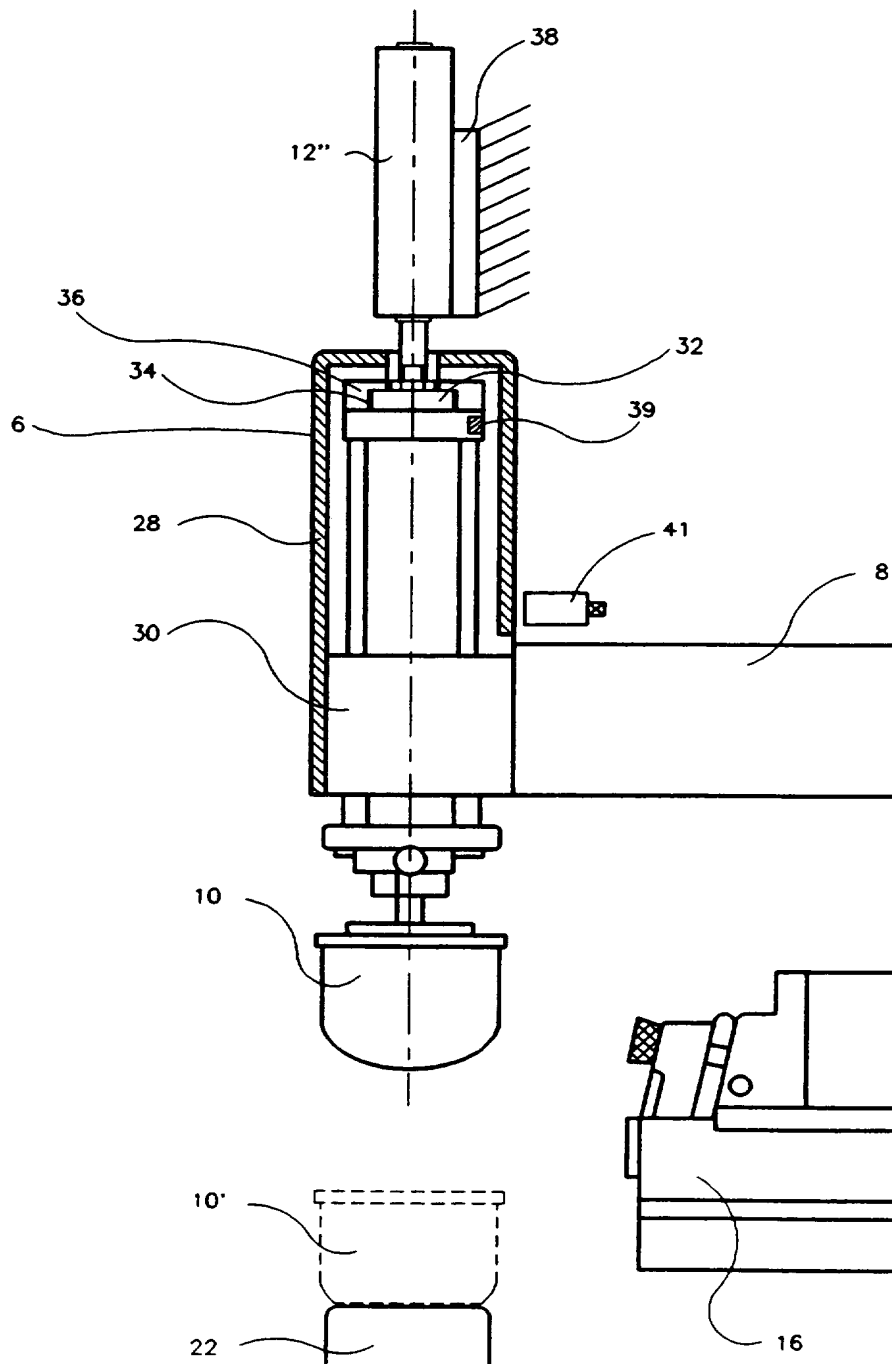


FIG. 3

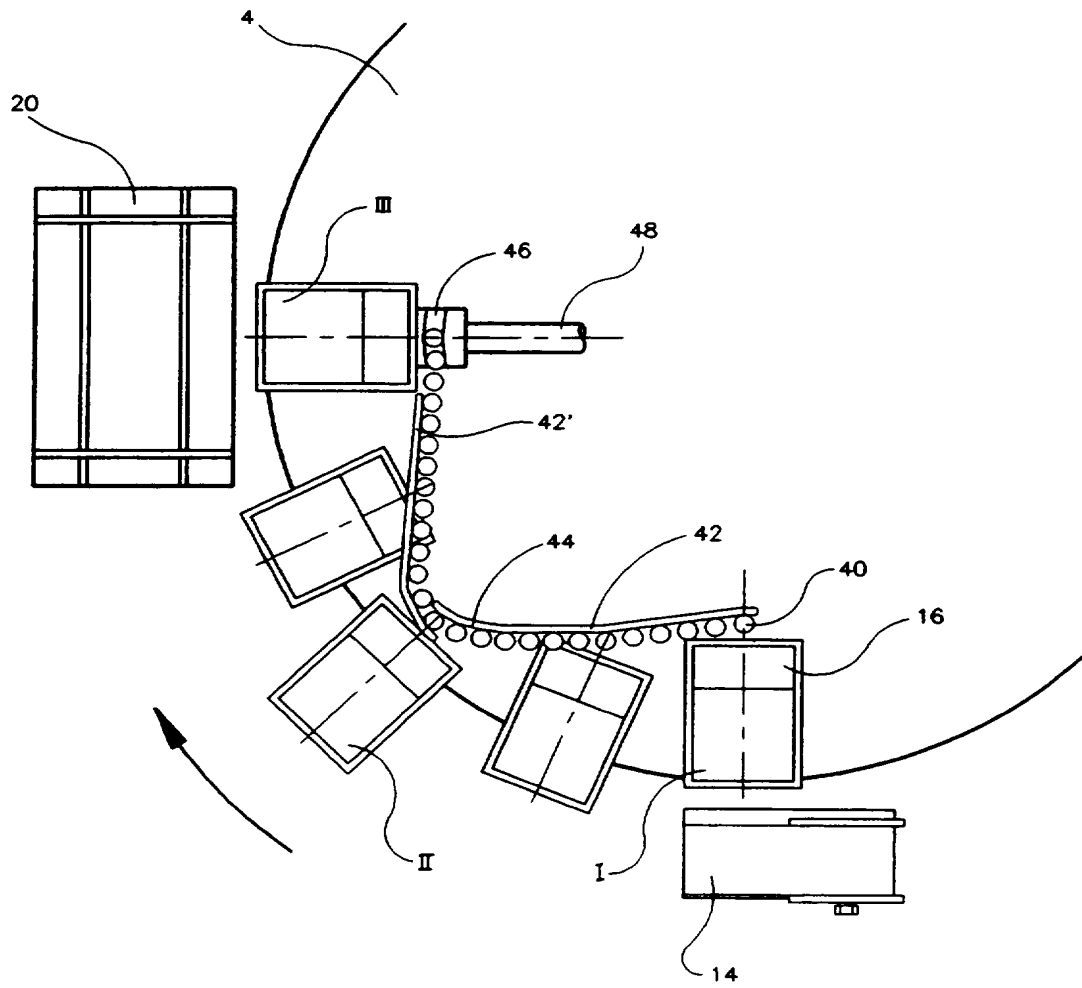


FIG. 4

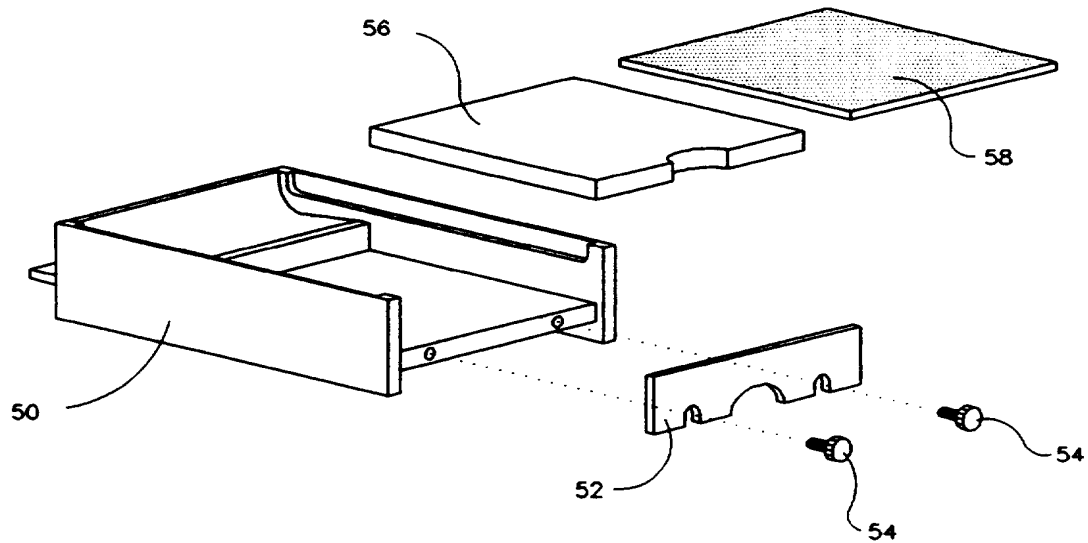


FIG. 5A

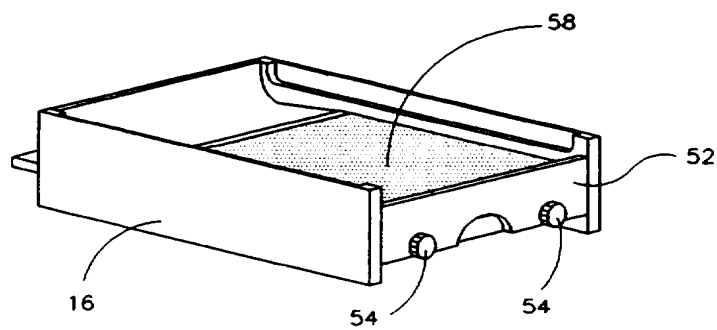


FIG. 5B

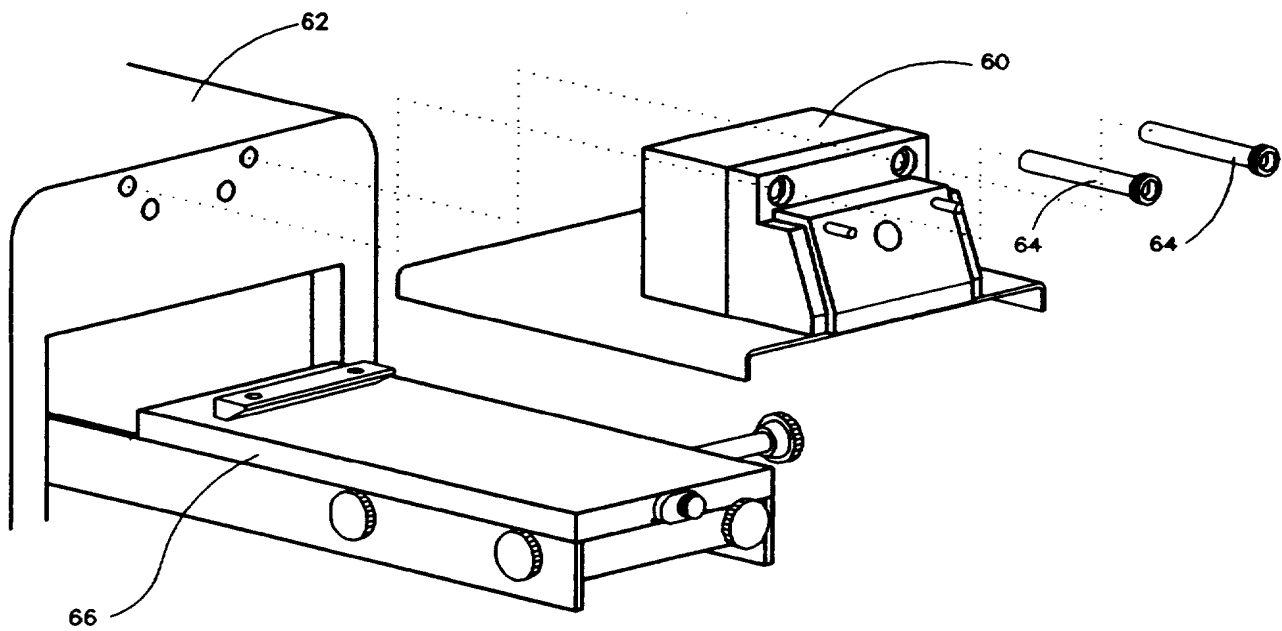


FIG. 6A

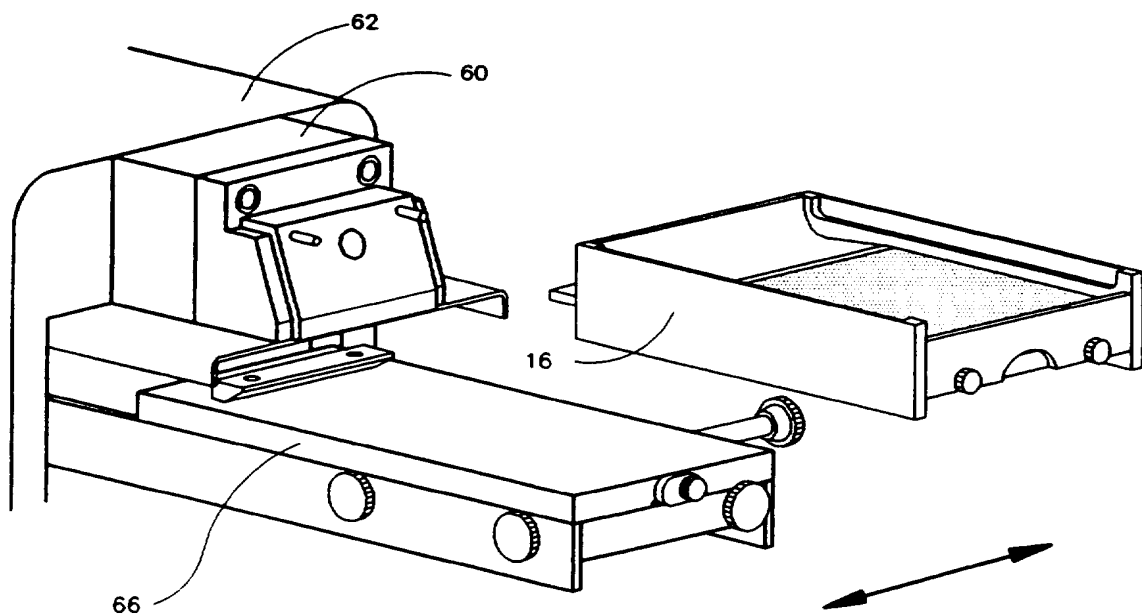


FIG. 6B

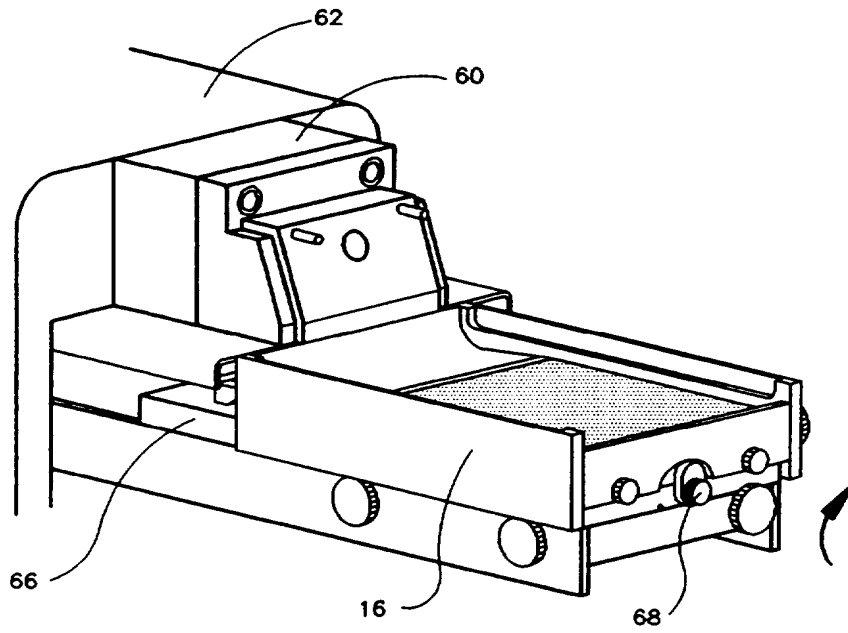


FIG. 6C

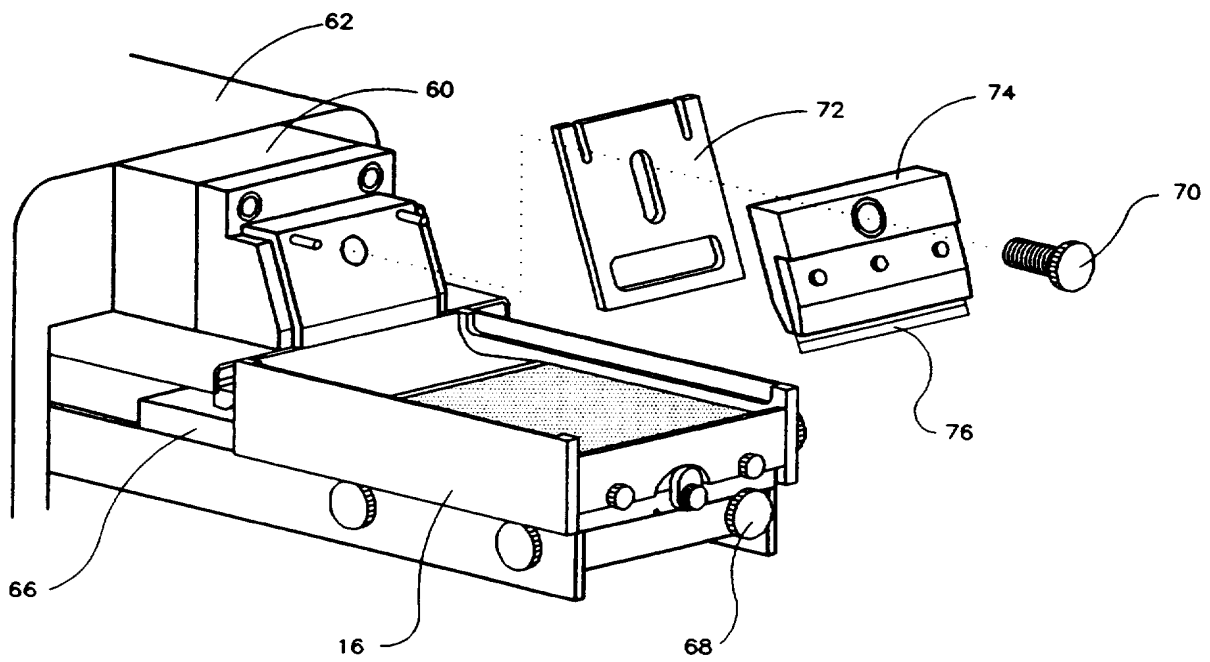


FIG. 6D

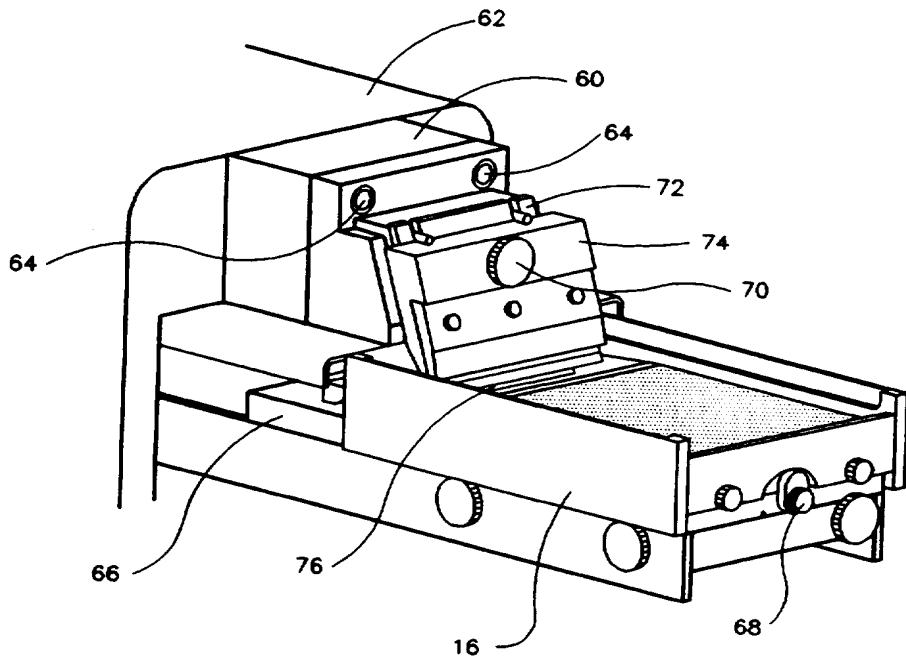


FIG. 7

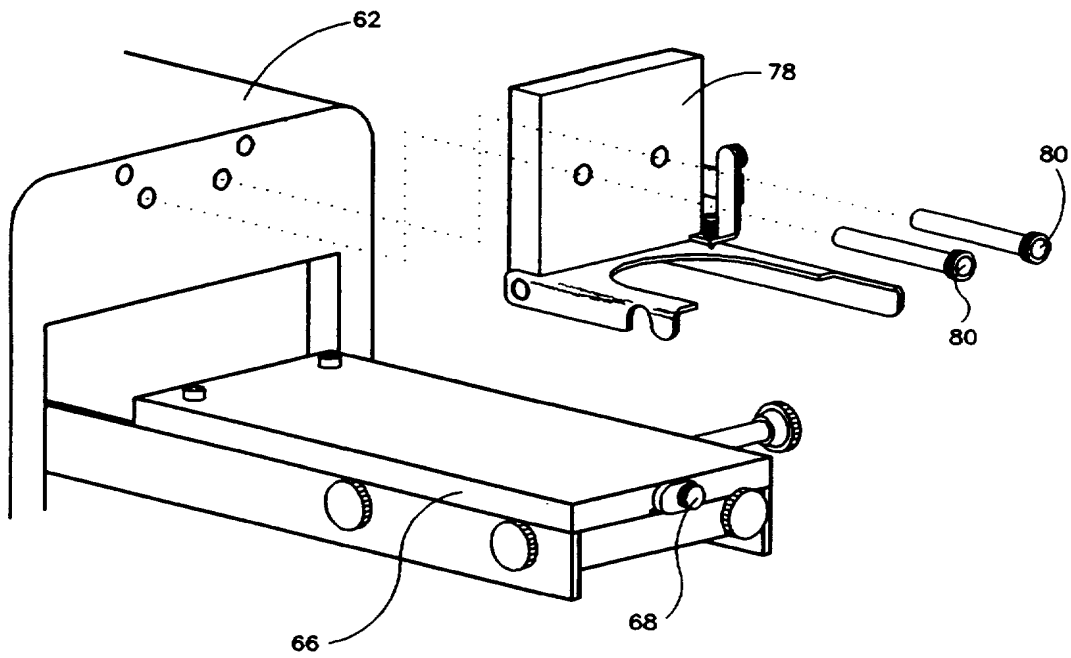


FIG. 8A

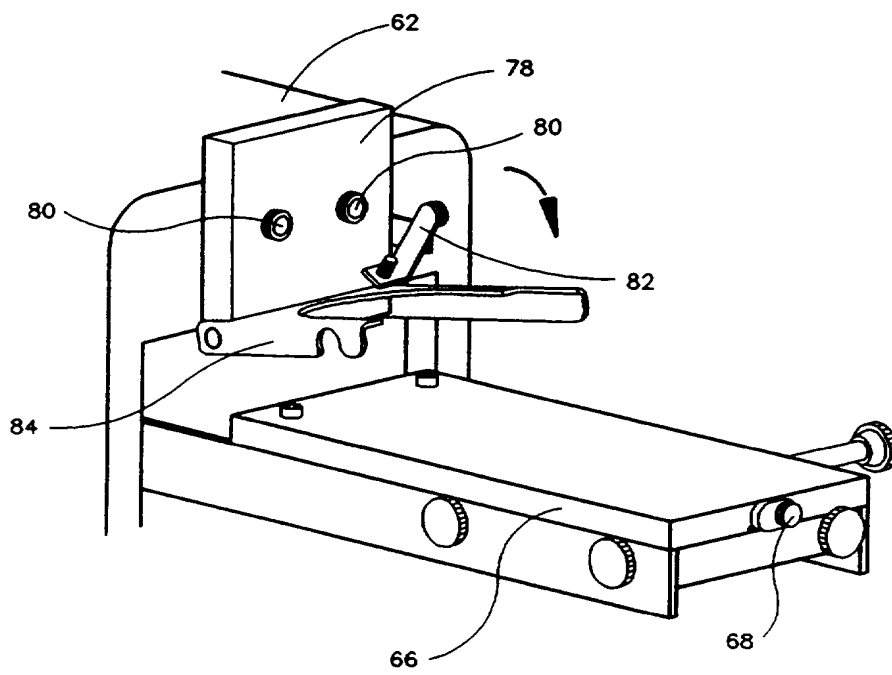


FIG. 8B

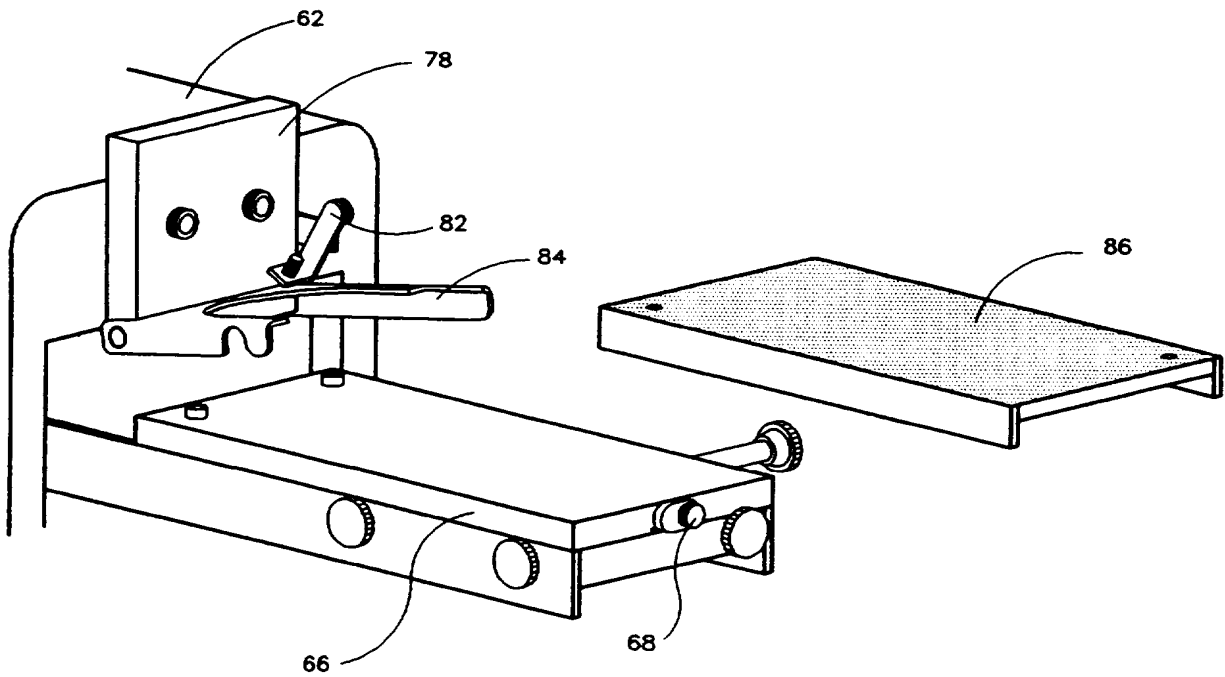


FIG. 8C

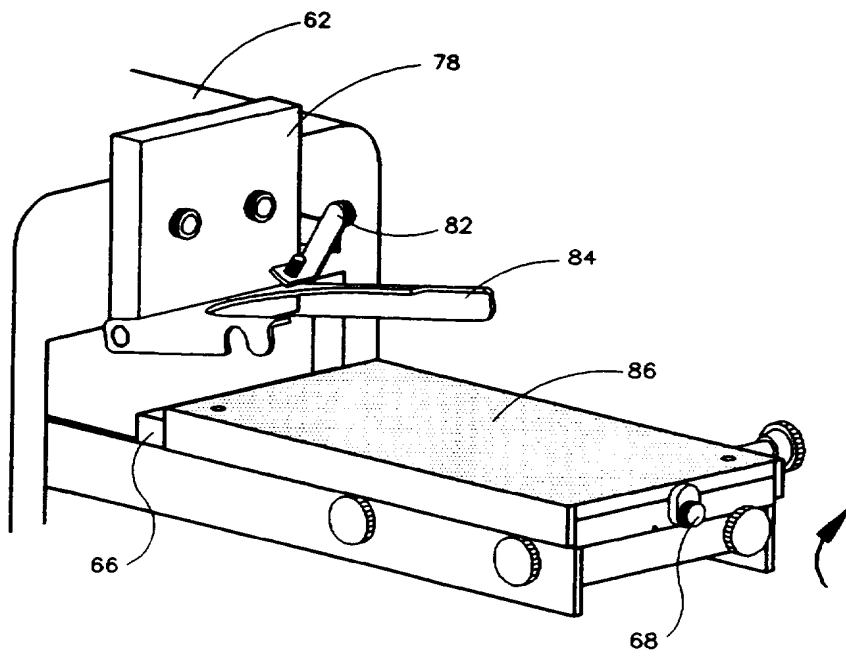


FIG. 8D

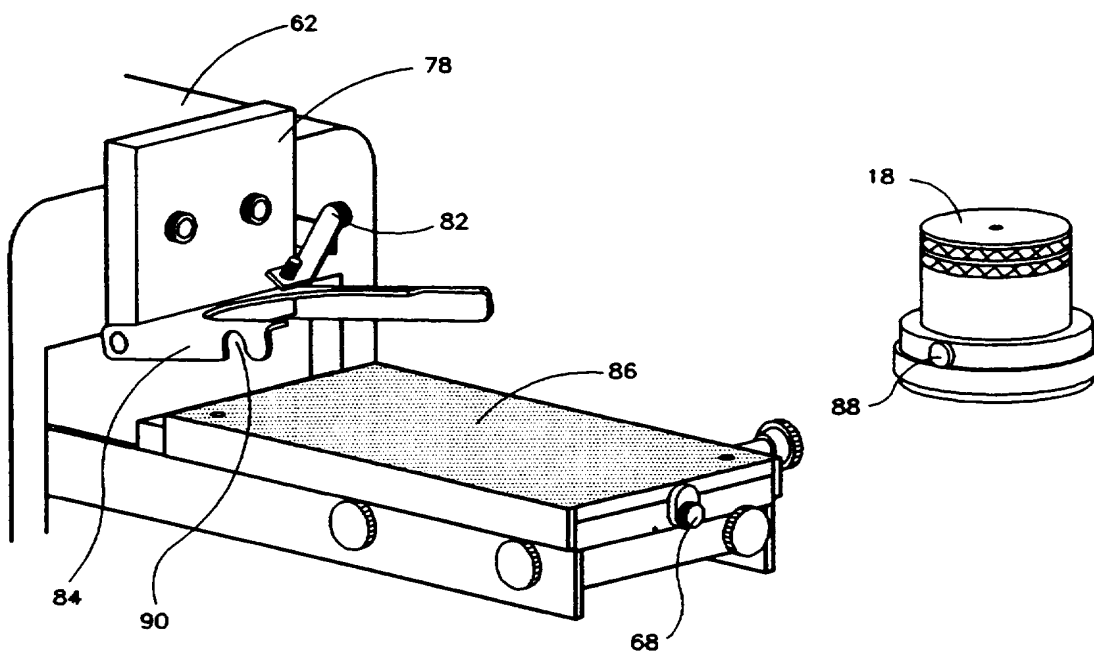


FIG. 8E

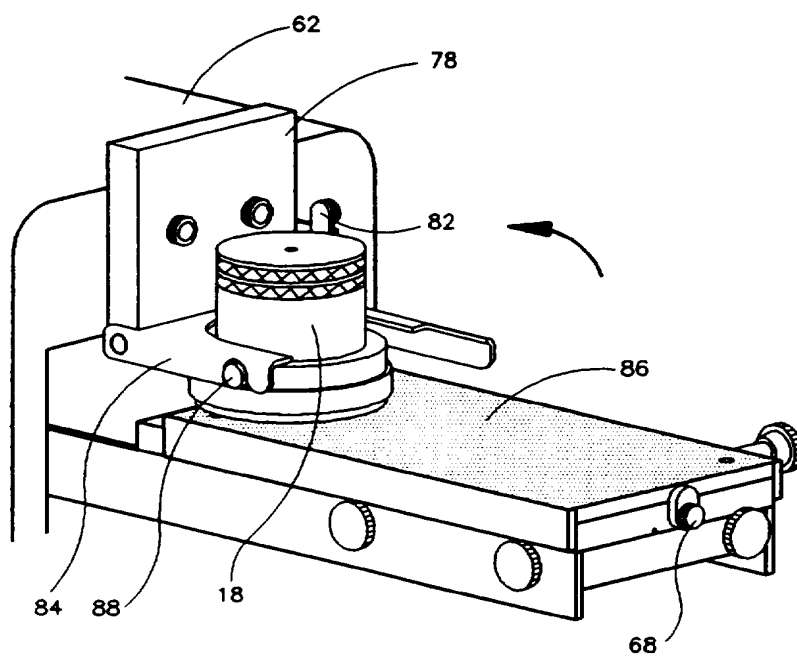


FIG. 8F

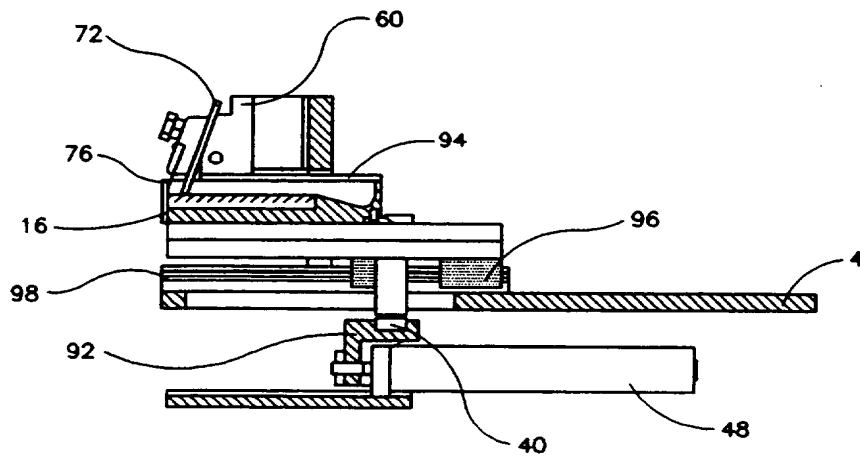


FIG. 9A

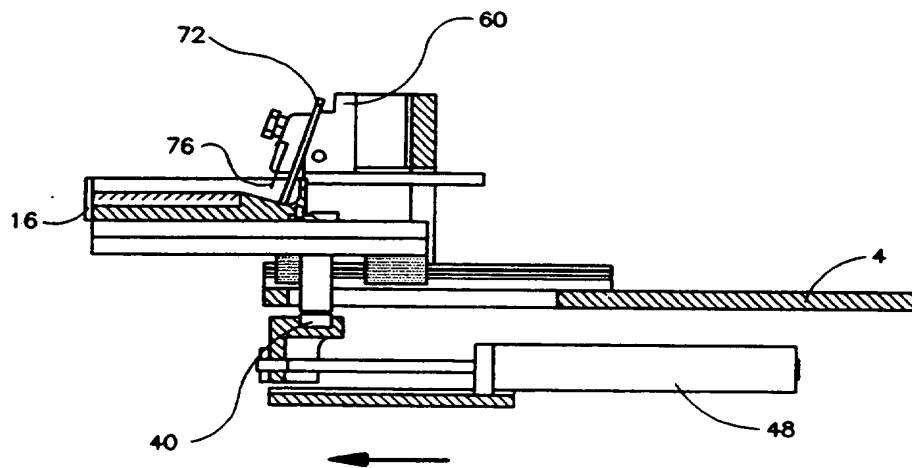


FIG. 9B

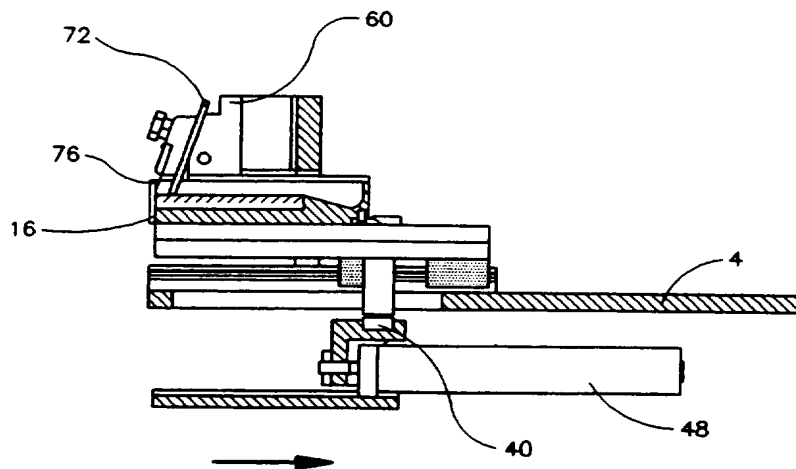


FIG. 9C

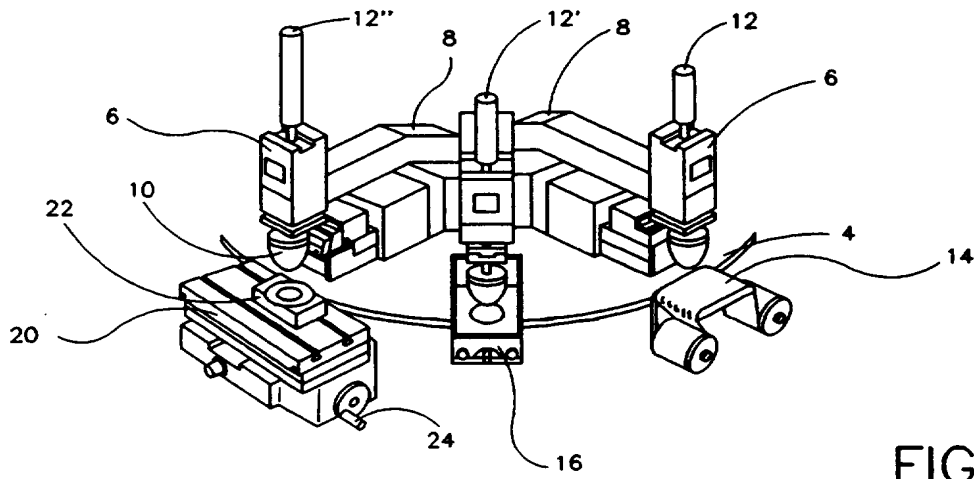


FIG. 10A

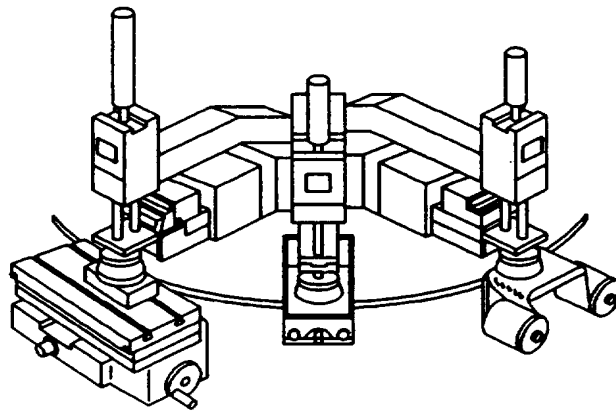


FIG. 10B

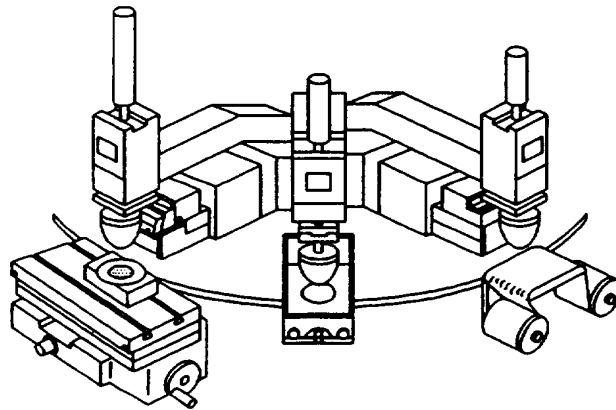


FIG. 10C

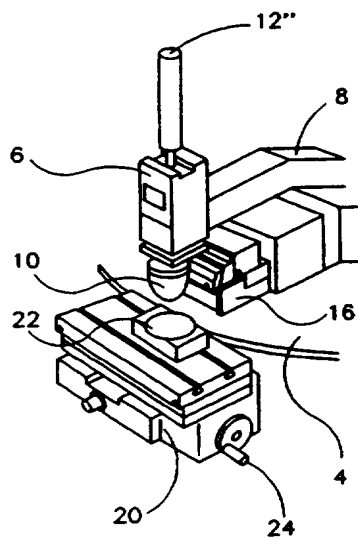


FIG. 11A

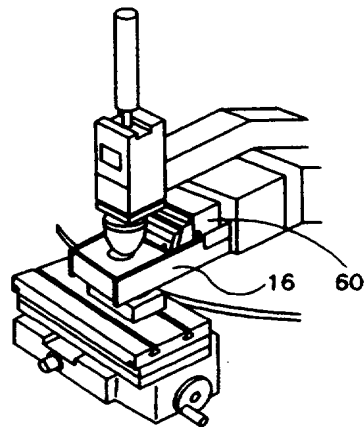


FIG. 11B

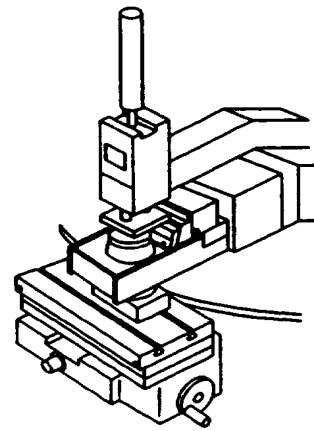


FIG. 11C

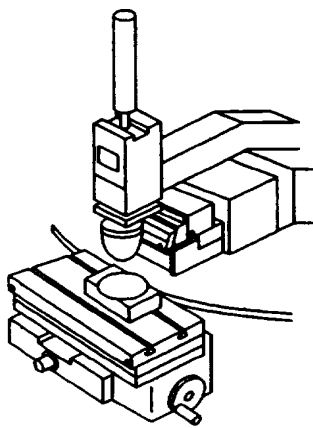


FIG. 11D

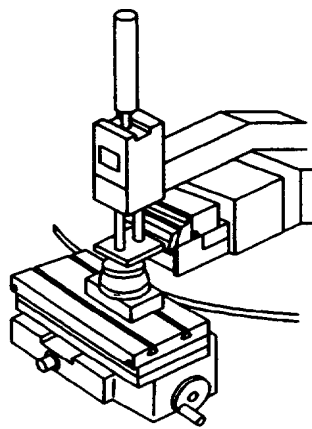


FIG. 11E

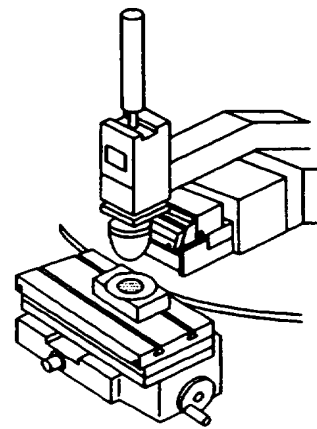


FIG. 11F

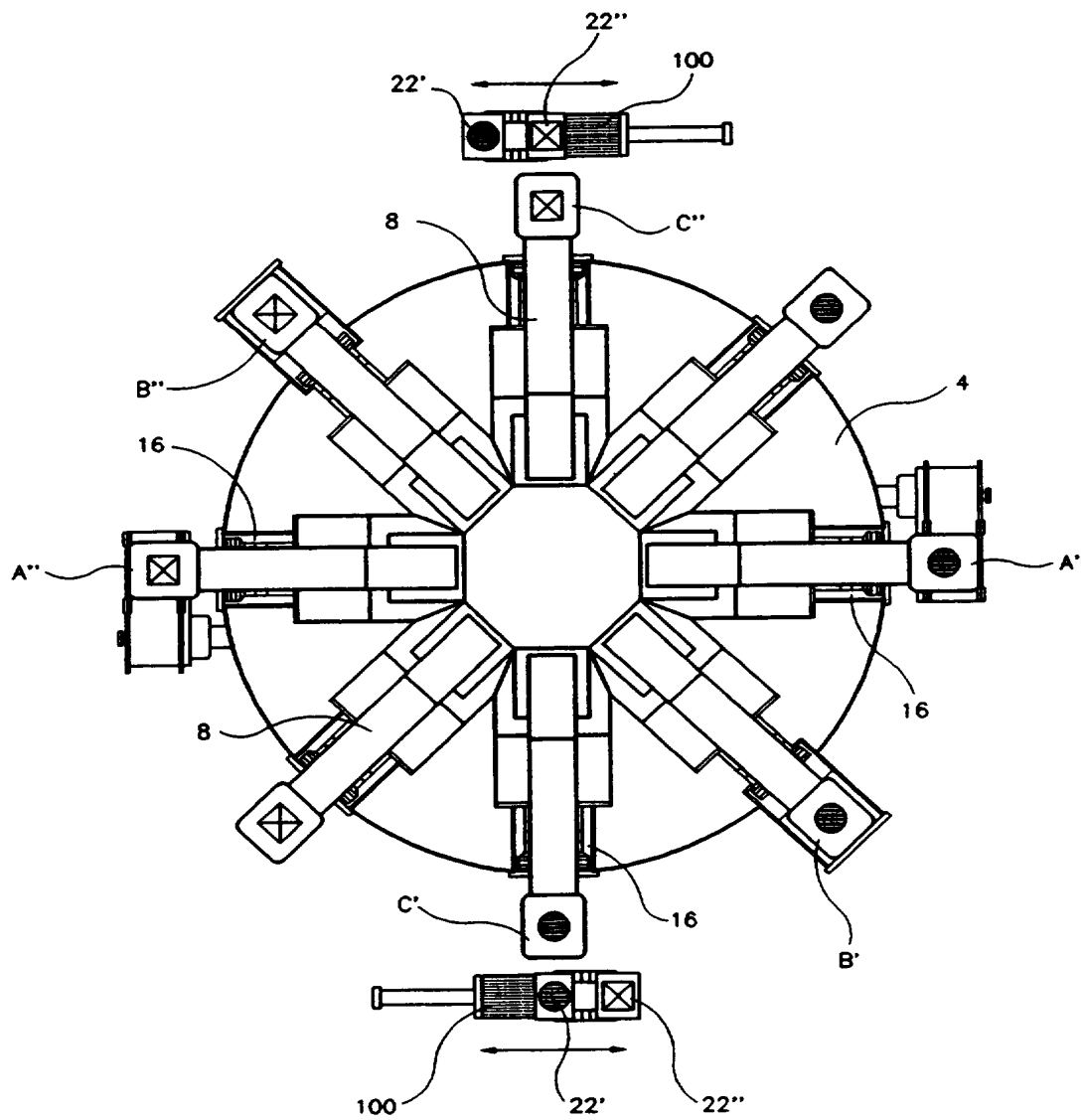


FIG. 12

A Printing Apparatus

This invention relates to a printing apparatus, and in particular, to a printing apparatus comprising a plurality of printing members rotatably movable about a substantially vertical axis.

There are known printing apparatus, e.g. pad printing apparatus, comprising a number of pad printers. Such pad printers are movable vertically to print an image or part of an overall image on a workpiece. In one such known pad printing apparatus, workpieces to be printed are placed on a number of holding jigs mounted on a closed-loop conveyor system. One disadvantage associated with such an arrangement is that the holding jigs have to be re-designed each time a new image is to be printed on a workpiece. This disadvantage is more significant when only a relatively small amount of workpieces are to be printed with a certain image.

It has been proposed to solve this problem by providing a printing apparatus in which the workpiece is placed on a stationary support, in which the pad printers are rotatable about a vertical axis constituted by the longitudinal axis of a shaft of a disc-shaped holding device, to the under-surface of which all the pad printers are joined. As all the pad printers are joined to the holding device, the movement of the shaft, and thus of the disc-shaped holding device, will bring about a corresponding movement of all the pad printers. As not all the pad printers are in a position where vertical movement thereof is required, such is not an efficient arrangement.

In addition, all existing printing apparatus are only capable of completing the printing

process of a workpiece at a time, such that the efficiency thereof is restricted.

It is therefore an object of the present invention to provide a printing apparatus wherein the aforesaid shortcomings are mitigated.

5

According to a first aspect of the present invention, there is provided a printing apparatus comprising a plurality of printing members rotatably movable about a substantially vertical axis, in which at least one of the printing members is movable to occupy one of a plurality of operable positions in which the printing member is
10 movable substantially vertically, wherein the vertical movement of the printing member in the or each operable position is independent of that of at least one other printing member.

15

According to a second aspect of the present invention, there is provided a printing apparatus comprising a plurality of printing members rotatably movable about a substantially vertical axis, wherein each printing member is movable to one of a plurality of first movable positions in which it is adapted to be moved to print a workpiece.

20

The invention will now be described by way of example only with reference to the accompanying drawings wherein:-

Fig. 1 shows a top view of a printing apparatus according to the present invention;

Fig. 2 shows a front view of the printing apparatus shown in Fig. 1;

Fig. 3 shows a partial sectional view of a printing member of the printing apparatus shown in Fig. 1;

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Fig. 4 shows the movement of an ink source of the printing apparatus shown in Fig. 1;

10

Figs. 5A and 5B show the set up of an ink tray of the printing apparatus shown in Fig. 1;

Figs. 6A to 6D show the installation of the ink tray in Figs. 5A and 5B to the printing apparatus shown in Fig. 1;

15

Fig. 7 shows an installed ink tray of the printing apparatus shown in Fig. 1;

Figs. 8A to 8F show the installation of an ink cup to the printing apparatus shown in Fig. 1;

20

Figs. 9A to 9C show the movement of the ink tray shown in Fig. 7 in operation;

Figs. 10A to 10C show the operation of the printing apparatus in Fig. 1 in an automatic printing mode;

Figs. 11A to 11F show the operation of the printing apparatus in Fig. 1 in a manual printing mode; and

Fig. 12 shows an alternative arrangement of the printing apparatus shown in Fig. 1.

5

Referring to Figs. 1 and 2, a printing apparatus according to the present invention is designated generally as 2. The printing apparatus 2 comprises a circular turntable 4 which is rotatable horizontally. Eight printing heads 6 circumferentially distributed about the central axis of the turntable 4 are joined to the turntable 4 each via a support arm 8. Each printing head 6 carries a printing pad 10 which may be moved vertically upon the actuation of one of three pneumatic cylinders 12, 12' and 12", further details of which are to be discussed below.

10

When a printing head 6 is rotated to occupy position A (cleaning position) as shown in Fig. 1, it is movable by the pneumatic cylinder 12 downward to contact a cleaning tape 14 to remove any ink attached to the corresponding printing pad 10.

15

Rotatable simultaneously with the turntable 4 are eight ink sources, each in the form of either an ink tray 16 or an ink cup 18. It should be noted that each of the ink trays 16 and/or ink cups 18 is situated substantially below a respective support arm 8. Apart from rotational movement about the central axis of the turntable 4, each of the ink trays/cups 16, 18 is also movable from a retracted position wherein they are nearest to the central axis of the turntable 4 to an extended position (indicated as "E" in Fig. 1) wherein it is farthest thereto. When a printing head 6 is rotated to occupy

20

position B (inking position) as shown in Fig. 1, it is movable by the pneumatic cylinder 12' downward to pick up ink from a corresponding ink tray 16 or ink cup 18. Further details regarding the radial movement of the ink tray 16 or ink cup 18 will be discussed below.

5

The printing apparatus 2 also includes a vertically movable printing station 20 on which a workpiece 22 may be placed. The vertical movement, and thus the height, of the printing station 20 is adjustable by rotation of an adjustment wheel 24. When a printing head 6 is rotated to occupy position C (printing position) as shown in Fig. 1, it may be moved by the pneumatic cylinder 12" downward to print the workpiece 22. The movement of the various components of the printing apparatus 2 is coordinated and controlled by a control unit 26.

10

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20

It should be noted that, in the arrangement as shown in Figs. 1 and 2, a printing head 6 is movable vertically only when it is in one of the cleaning, inking and printing positions and that such movement will not necessarily bring about corresponding movement of other printing heads 6 occupying other positions. It is also clear that, by this arrangement, each workpiece 22 may stay stationary and be printed with at most eight partial images, each of a different colour, to form a resultant image. The three pneumatic cylinders 12, 12' and 12" may alternatively be arranged to move synchronously, so that the corresponding printing heads 6 may also be moved together. Even with such an arrangement, the movement of printing heads 6 in the cleaning, inking and printing positions will not bring about corresponding movement of other printing heads 6 in other positions.

Turning to Fig. 3, a partial cross-sectional view of a printing head 6 is shown to comprise an aluminum casting housing 28 containing a carriage 30, to which the printing pad 10 is attached. The pneumatic cylinder 12" includes a plug 32 at its lower end which is receivable into a slot 34 of a socket 36 of the printing head 6.

5 The vertical movement of the pneumatic cylinder 12" is guided by a cylinder support 38. The stroke depth (i.e. the vertical distance allowed to be travelled) of the pneumatic cylinder 12", and thus that of the printing head 6 is determined by a magnet 39 of the carriage 30 and the positioning of a sensor 41. Downward movement of the carriage 30 will be halted and the pneumatic cylinder 12" will be
10 retracted when the magnet 39 is detected by the sensor 41, e.g. when the magnet 39 is on substantially the same horizontal level as the sensor 41. It is therefore possible to adjust the stroke depth of each individual printing head 6 by varying the positions of the corresponding sensor 41 and/or magnet 39. Due to the different height of the workpiece 22, ink tray 16 or ink cup 18 and the cleaning tape 14, the stroke depths
15 of the cylinders 12, 12' and 12" are adjusted to be different. In the position shown in Fig. 3, the pneumatic cylinder 12" is movable downward to move the printing pad 10 to the position 10' so as to print a workpiece 22. The arrangement of the pneumatic cylinders 12 and 12' in the cleaning and inking positions is essentially the same.

20 Referring to Fig. 4, which shows a partial top view of the printing apparatus 2 is shown with the printing heads 6 and support arms 8 removed for clarity purposes, an ink tray 16 is shown as being moved from position I (cleaning position) to position II (inking position) and subsequently position III (printing position), as indicated by

the arrow. Position I corresponds to position A; position II corresponds to position B; and position III corresponds to position C referred to in Fig. 1. When the ink tray 16 is in the cleaning position, it is in a retracted position where it is nearest to the central axis of the turntable 4. A nylon bearing 40 of with this ink tray 16 is received by and movable along one of a pair of guide rails 42 and 42' of a cam member 44 on the top surface of the turntable 4. Upon the rotation of the turntable 4 in the direction of the arrow, the bearing 40 moves along the guide rail 42 and thus moves the ink tray 16 away from the central axis of the turntable 4. When the bearing 40 is received between the two guide rails 42 and 42', the ink tray 16 occupies the inking position and is farthest away from the central axis of the turntable 4. In this position, the ink tray 16 extends beyond the periphery of the turntable 4 and is therefore adapted to be approached by a corresponding printing pad 10 to absorb ink contained in the ink tray 16. Once this position is passed, the bearing 40 moves along guide rail 42' and thus moves the ink tray 16 back from the extended position. When the ink tray 16 reaches the printing position, the bearing 40 is received into a cavity 46 of a manually operable pneumatic cylinder 48, which is operable to move the ink tray 16 radially, further details of which will be discussed later.

Figs. 5A and 5B show the assembly of an ink tray 16 which may be used in the present invention. As shown in more details in Fig. 5A, the ink tray 16 includes a tray member 50 to the front end of which is secured a front plate 52 by a pair of screw knobs 54. A magnet plate 56 is received within the tray member 50, and on the top of the magnet plate 56 is placed a polymer plate 58. The bottom of the

polymer plate 58 is provided with magnetically-attractive material so as to enable the polymer plate 58 to be more firmly held to the magnet plate 56.

5 Figs. 6A to 6D show the procedure for the installation of the ink tray 16 to the printing apparatus 2. As shown in Fig. 6A, a blade assembly 60 is secured to an ink container receiving member 62 by a pair of screws 64. The ink tray 16 is then placed on a platform 66 which is movable both vertically and in the direction as shown in the arrow in Fig. 6B. The ink tray 16 is locked to the platform 66 by rotating a lock knob 68 in the direction as shown by the arrow in Fig. 6C. As shown in Fig. 6D, to the blade assembly 60 is secured, by a screw 70, a spatule 72 and a blade holder 74 holding a blade 76. A completed ink tray assembly is shown in Fig. 7.

15 Instead of an ink tray, a magnetic ink cup 18 may instead be used. Figs. 8A to 8F show the installation of an ink cup 18 to the printing apparatus 2. As shown in Fig. 8A, an ink cup assembly 78 is securable to the ink container receiving member 62 by screws 80. A locking handle 82 of the ink cup assembly 78 may be pulled down in the direction shown by the arrow in Fig. 8B to raise a retainer bracket 84. A polymer plate 86 is placed onto the platform 66 of the ink container receiving member 62 and may be locked thereto by turning the locking knob 68 in the direction shown by the arrow in Fig. 8D. The magnetic ink cup 18 may be received by the retainer bracket 84 of the ink cup assembly 78. To enhance the connection between the retainer bracket 84 and the magnetic ink cup 18, the magnetic ink cup 18 may comprise a protrusion 88 receivable into a recess 90 of the retainer bracket 84. To

complete the assembling procedure, the locking handle 82 is pulled up in the direction of the arrow shown in Fig. 8F to lower the retainer bracket 84 such that the magnetic ink cup 18 contacts the top surface of the polymer plate 86.

5 Figs. 9A to 9C show the movement of the ink tray 16 at the printing position in the manual operation mode. At this position, the nylon bearing 40 of the ink tray 16 is received into the cavity 46 of a linkage block 92 of the pneumatic cylinder 48. The ink tray 16 is covered by a metal cover 94. Upon the extension of the pneumatic cylinder 48, the linkage block 92 is extended and thus drives the ink tray 16 radially outward, while the blade assembly 60 stays stationary. The movement of the ink tray 10 16 is guided by a runner block 96 which is movable along a rail 98. Upon the release of the pneumatic cylinder 48, the ink tray 16 is moved backward and the bearing 40 leaves the linkage block when the turntable 4 rotates further.

15 The printing procedure may be effected automatically, as shown in Figs. 10A to 10C. Upon the rotation of the turntable 4, a printing head 6 just cleaned by the cleaning tape 14 at the cleaning position is rotated to the inking position. The ink tray 16 associated with this printing head 6 is moved radially outward by the cam member 44, whereby the blade 76 scratches the surface of the polymer plate 58 with image and thus leaves ink in the etched pattern. Turning to Fig. 10B, each of the printing 20 heads 6 at the cleaning, inking and printing positions is then acted upon by a corresponding cylinder 12, 12' and 12". As shown in Fig. 10B, the printing head 6 at the cleaning position is pushed downward so that ink residue on the printing pad 10 is removed by the sticky cleaning tape 14; the printing head 6 at the inking

position is pushed downward so that the image left on the outwardly extended ink tray 16 is picked up by the printing pad 10; and the printing head 6 at the printing position is pushed down to transfer the previously picked up image to the workpiece 22 on the printing station 20. As shown in Fig. 10C, the printing heads 6 are then driven up by the respective cylinders 12, 12' and 12", and the turntable 4 rotates such that the printing head 6 originally in the cleaning position is rotated to occupy the inking position and the printing head 6 originally in the inking position is rotated to occupy the printing position.

The printing procedure may, as indicated above, alternatively be effected manually, as shown in Figs. 11A to 11F. The workpiece 22 is placed on the printing station 20 and a manual operation switch (not shown) may be pressed to actuate the pneumatic cylinder 48 and thereby to control the radial movement of the ink tray 16. Upon the outward movement of the ink tray 16, the corresponding blade 76 scratches the surface of the polymer plate 58 and thus leaves ink in the etched pattern. The cylinder 12" at the printing position then pushes the printing pad 10 down to pick up the image from the ink tray 16. It should be noted that the printing station 20 is adjusted to such a height that it does not obstruct the outward movement of the ink tray 16. The printing pad 10 is subsequently driven up and the ink tray 16 is also driven back so that the polymer plate 86 is flooded with ink by the spatula 72. The printing pad 8 is again driven down by the cylinder 12" so that the image previously picked up is transferred on to the workpiece 22. The printing pad 10 is again driven up to allow the next sequence of operation.

It is possible to so arrange the printing apparatus 2 that more than one workpiece may be printed and finished at the same time. As shown in Fig. 12, two sets of cleaning positions A', A", inking positions B', B" and printing positions C', C" are provided. Such an arrangement may be used for printing two workpieces of the same resultant image or, as shown in Fig. 12, for printing two workpieces each of a different resultant image. To effect this latter result, the printing apparatus 2 includes two shuttle attachments 100 each supporting two workpieces 22' and 22" each to be printed with a different resultant image. The printing heads 6 and the associated ink trays 16 are arranged such that those printing heads 6 marked with a dot are to print the workpieces 22' and those marked with a cross are to print the workpieces 22". The shuttle arrangements 100 are actuatable to reciprocate in the direction shown in the arrows and their movement is co-ordinated with that of the turntable 4 so that the correct product is placed in the printing position when the appropriate printing head 6 comes to the printing position.

It should be understood that the above only illustrates an embodiment of the present invention and it is thus possible that further variations thereto may be made without departing from the gist of the invention. For example, it is possible to so arrange the printing apparatus that three or more workpieces be worked simultaneously.

CLAIMS:-

1. A printing apparatus comprising a plurality of printing members rotatably movable about a substantially vertical axis, in which at least one of the printing members is movable to occupy one of a plurality of operable positions in which the printing member is movable substantially vertically, wherein the vertical movement of the printing member in the or each operable position is independent of that of at least one other printing member.
2. A printing apparatus according to Claim 1 wherein at least one of the printing members is movable to occupy a first operable position in which the printing member(s) is (are) adapted to be moved to be cleaned.
3. A printing apparatus according to Claim 2 wherein at least one of the printing members is movable to occupy a second operable position in which the printing member(s) is (are) adapted to be moved to absorb ink from an ink source.
4. A printing apparatus according to Claim 3 wherein at least one of the printing members is movable to occupy a third operable position in which the printing member(s) is (are) adapted to be moved to print a workpiece.
5. A printing apparatus according to Claim 4 wherein each printing member is adapted to occupy the first operable position, the second operable position and

the third operable position consecutively.

6. A printing apparatus according to any of the preceding claims wherein each printing member occupying an operable position is adapted to be moved substantially vertically by an actuating means.

7. A printing apparatus according to Claim 6 wherein the maximum distance travelled by at least one printing member is different from that of at least one other printing member.

8. A printing apparatus according to Claim 7 wherein the actuating means comprises a pneumatic cylinder.

9. A printing apparatus according to any of the preceding claims further comprising a support means for supporting the workpiece, wherein the support means is adjustably movable substantially vertically.

10. A printing apparatus according to Claim 9 wherein the support means is substantially below the printing member when the latter is in the third operable position.

11. A printing apparatus according to any of the preceding claims further comprising at least one ink storage means rotatably movable about a substantially vertical axis.

12. A printing apparatus according to Claim 11 wherein the substantially vertical axis about which the at least one ink storage means is rotatably movable coincides with that about which the printing members are rotatable.
- 5 13. A printing apparatus according to Claim 11 or 12 wherein each printing member is rotatably movable synchronously with an ink storage means.
14. A printing apparatus according to Claim 13 wherein the ink storage means is farthest away from the axis about which it is rotatable when its corresponding
10 printing member is in the second operable position.
15. A printing apparatus according to any of the preceding claims further comprising at least four printing members.
- 15 16. A printing apparatus according to Claim 15 further comprising at least eight printing members.
17. A printing apparatus according to any of the preceding claims wherein the printing member is rotatably movable to at least one inoperable position
20 wherein the printing member is not vertically movable.
18. A printing apparatus according to Claim 17 wherein the vertical movement of the printing members in the first, second and third operable positions is synchronized.

19. A printing apparatus comprising a plurality of printing members rotatably movable about a substantially vertical axis, wherein each printing member is movable to one of a plurality of first movable positions in which it is adapted to be moved to print a workpiece.

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20. A printing apparatus according to Claim 19 further comprising a plurality of support means, each adapted to support at least one workpiece to be printed.

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21. A printing apparatus according to Claim 20 wherein the support means are movable substantially vertically.

22. A printing apparatus according to Claim 20 or 21 wherein the support means comprises a support member reciprocably movable substantially horizontally.

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23. A printing apparatus according to any one of Claims 19 to 22 wherein each support member is adapted to support a plurality of workpieces.

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24. A printing apparatus according to any one of Claims 19 to 23 wherein each printing member is movable to one of a plurality of second movable positions in which it is adapted to be moved to be cleaned.

25. A printing apparatus according to Claim 24 wherein each printing member is movable to one of a plurality of third movable positions in which it is adapted to be moved to absorb ink from an ink source.

26. A printing apparatus according to Claim 25 further comprising an equal number of first, second and third movable positions.
27. A printing apparatus according to Claim 26 further comprising a plurality of sets of movable positions, each comprising a first movable position, a second movable position and a third movable position.
28. A printing apparatus according to Claim 27 wherein each set of the movable positions are arranged such that the printing members are adapted to be rotatably movable from a second movable position, to a third movable position, then to a first movable position consecutively.
29. A printing apparatus according to Claim 28 further comprising at least two sets of movable positions.
30. A printing apparatus according to Claim 29 wherein at least two workpieces are adapted to be printed simultaneously.
31. A printing apparatus according to Claim 30 wherein the printing members are adapted to print each one of the set of workpieces to be printed simultaneously with a different resultant image.
32. A printing apparatus substantially as hereinbefore described and with reference to the accompanying drawings.

Patents Act 1977**Examiner's report to the Comptroller under Section 17
(The Search report)**

Application number

GB 9519936.0

Relevant Technical Fields

(i) UK Cl (Ed.N) B6C: CBBM, CBBT, CBDB

(ii) Int Cl (Ed.6) B41F: 17/00, 15/08

Search Examiner

A DAVEY

Date of completion of Search

22 NOVEMBER 1995

Databases (see below)

(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

Documents considered relevant following a search in respect of Claims :-

1-32

(ii) ONLINE: WPI

Categories of documents**X:** Document indicating lack of novelty or of inventive step.**P:** Document published on or after the declared priority date but before the filing date of the present application.**Y:** Document indicating lack of inventive step if combined with one or more other documents of the same category.**E:** Patent document published on or after, but with priority date earlier than, the filing date of the present application.**A:** Document indicating technological background and/or state of the art.**&:** Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 1303850 A	(RIDGWAY) note pads in Figure 1	1, 19 at least
X	GB 1317060 A	(PHILIPP) note Figures 1 and 7	1, 19 at least
X	US 5383398	(BINNEN) whole document	19 at least
X	US 5315929	(SUNDQVIST) note especially Figure 1	1, 19 at least
X	US 4543883	(SUN CHEMICAL) note vertical movement of subframes, Figure 1	1, 19 at least
X	US 4084504	(FUCHS) whole document	1, 19 at least

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).